PATENT SPECIFICATION

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(54) MOVABLE SURFACE APPARATUS, PARTICULARLY FOR PHYSICAL EXERCISE AND TRAINING

(71) I, ROLF SCHÖNENBERGER, of Swiss Nationality, of Stapferstrasse 35, 8006 Zurich, Switzerland, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be described in and by the following statement:—

The present invention relates to a movable support surface apparatus for physical exercise and training use, which may be motor drive, and with which a person standing on the surface may walk, run, or engage in similar exercise.

Various types of movable support surfaces, usually constructed with an endless belt, or the like, have been proposed. Usually, an endless wide rubber belt is supported throughout its width by a stationary support in order to prevent bowing due to the weight of the user. As the movable rubber belt engages the back-up support surface, substantial friction between the rubber belt and the support surface arises, requiring substantial drive power. The rubber belt is subject to wear due to friction between it and the support. The feel of the step on the rubber belt is disagreeable since it is hard, because the thickness of the rubber belt is limited.

It is the object of the present invention to provide a movable support surface apparatus which has a low noise level when operating, and provide a pleasant, springy feed when being stepped or jumped on without, however, being excessively stressed by bending or bowing.

According to the present invention, a movable surface apparatus, for physical exercise and training, comprises:—

(i) a support frame
(ii) at least one pair of rotatable elements carried by the frame and having their axes substantially horizontal
(iii) belt means looped about said rotatable elements so as to include an upper run and a lower run
(iv) a plurality of transverse slat means secured externally on the belt means
(v) a plurality of support rollers disposed in a row beneath the upper run of the belt means with their axes of rotation parallel to each other and to the axis of rotation parallel to each other and the axis of rotation of the rotatable elements.
(vi) resiliently deformable cushioning means disposed between the support rollers and the underside of the slats for supporting the slats in cushioned manner.

The construction substantially reduces friction and wear on the movable surface, and where the device is motor driven permits operation with low power. Additionally, the apparatus operates with low noise level while providing a pleasant feel when being stepped upon, by resiliently slightly yielding without, however, bowing through or bending in the middle.

Some embodiments of the invention are described hereinafter by way of example with reference to the accompanying drawings, wherein:

Fig. 1 is a general perspective view of a training and physical exercise apparatus;

Fig. 2 is a schematic side view of the movable surface and its drive arrangement, with the housing removed;

Fig. 3 is a plan view of the movable surface with part of the housing broken away;

Fig. 4 is a perspective view of the attachment arrangement of the slats to the drive belt;

Fig. 5 is a sectional view of a modification;

Fig. 6 is a sectional view of another modification;

Fig. 7 is a transverse cross-section view of another modification;

Fig. 8 is a transverse cross-section of another embodiment;

Fig. 9 is a longitudinal section of the embodiment of Fig. 8;

Fig. 10 is a fragmentary part sectional view of yet another embodiment.

The physical exercise apparatus illustrated in Fig. 1 is driven by a motor 33 (Figs. 2, 3) which drives a movable surface 1. A person standing on the surface, in order to remain on the apparatus, must walk, jog or run. The apparatus is enclosed in a housing 2 to which support bars 3 are also secured. A control unit *C* is mounted on one of the support bars to control operation of the motor, for example, for its starting stopping, and controlling of its operating speed.

The movable surface 1 is supported on a frame 36, 37 (Fig. 2) shown schematically only, and surrounded by the housing 2. The frame 36/37 may have any suitable structure. Two rotatable driving drums 10 or pairs of drums are disposed at the ends of the frame. The endless driving belts 5(Fig. 4) having internally projecting teeth 7 are engaged with the driving drums 10, thus ensuring slipless positive common drive of both of the drive belts 5 in the operating direction, as shown by arrow *A* in Fig. 2. The driving belts 5 are flexible and are made of rubber or flexible plastics material. One of the driving drums 10 is driven by motor 33, or by any other suitable motive drive apparatus, by means of a drive belt 34 (Fig. 3), preferably with interposition of a speed-reducing means. The motor is controlled from controller *C* (Fig. 1). The driving belt 5 (Fig. 4) has a group of step slats 4 secured thereto. The slats 4 have a solid base of light-weight metal, for example of aluminium, which is secured to the belt 5 by rivet 9. The slats extend transversely to the running direction (arrow *A*) of the movable surface. The slats 4 have a generally T-shaped cross-section, and have a centre web 8. The centre web 8 terminates short of each end of the slat. The region of connection of the slats 4 to the driving belts 5 is reduced with respect to the width of the slats 4 to form a substantially rectangular tongue 38 (Fig. 4) having a width *B* and a length *L* to prevent noise when the slats are moving from a vertical position around the drum into a horizontal position. The width *B* is less than the width of the slats 4; the extent to which the web 8 stops short of the end of the slat is greater than the lenght *L*. The distance between adjacent step slats 4 is so selected that only a small space or clearance is left between the slats—just enough to prevent interference of adjacent slats upon movement. The upper surface of the slats 4 is covered with an impact-reducing cover 16 (Fig. 5; omitted from Fig. 4 for clarity) to provide for soft engagement when stepping on the surface, and to provide a pleasantly yielding step protecting the limbs and ligaments. The material for cover 16 may be rubber, cork, dense sponge rubber, plastics foam, artificial lawn surfacing, indoor/outdoor carpeting, particularly with rubber backing, or the like.

Support rollers 12 are provided to prevent bending of the driving belts 5 upon loading of the slats by a person. The slats 4 are supported adjacent each of their ends by a respective support belt 13. Each of the two support belts 13 is made of rubber, or other elastic material and may, for example, be a flat belt, or a V-belt. Each of the belts 13 is supported by a group of the adjacently located support rollers 12. The support rollers are fixed in position, and are rotatable about their axes. They support the upper run of the movable surface and are present throughout at least the entire useful length of the support surface between the two driving drums 10. The diameter of the support rollers 12 is less than the diameter of the driving drums 10. To provide for good lateral guidance of the support belt 13, at least some of the support rollers 12 are formed with radially projecting shoulders.

The support rollers 12, as best seen in Figs. 5 and 7, are mounted rotatably on shafts 21 secured to a U-channel 20. The U-channels 20 are carried by transversely located angle, T, or channel rails 32, secured to the frame of the apparatus. The connection between the U-channels 20 and the rails 32 is preferably by screws 28, although any other suitable connection may be used, such as welding. The support rollers 12 are journalled by means of low-friction bearings, for example needle bearings or ball bearings, although sleeve bearings operating with low friction with respect to shaft 21 may also be used. The spacing between the upper surface of the support belt 13 and the underside 14 of the step slat 4 is so selected that a small distance, of the order of for example about $\frac{1}{2}$ cm, is left when the surface 1 is unloaded. Upon loading, for example by the user stepping on a slat 4, the underside 14 of the respective slat 4 will bear on the support belt 13. Support belt 13 is carried along in the direction of the arrow *A* (Fig. 2) when abutted by the lower surface of the respective step slat 4, so that the support rollers 12 likewise begin to rotate. The support belt 13 will then move with the same speed as the movable surface 1. Since the shafts 21 of the support rollers 12 are fixedly located in the frame, there is practically no downward bowing of the driving belts 5, since vertical forces applied to the step slats 4 are borne by the support rollers 12. Thus, the upper run of the

movable surface is practically flat, while being slightly springy, and resembles that of a natural soft, grass or other soft-surface athletic track.

Fig. 6 illustrates another embodiment of the invention in which very small support rollers 12' are used, located immediately adjacent each other, each supported on a respective bolt 21'. The rollers are so dimensioned that in any position of the slat 4, at least two rollers 12' are in supporting engagement with a respective slat, as shown, the arrangement of three rollers in engagement with a slat is preferred.

Instead of having a support belt 13 which is separate from the slats, the underside 14 of the slats 4 may have a support belt in the form of a yielding layer 17 secured thereto, made of for example rubber or other elastic material, in order to provide for elastic spring support of the respective slat 4 on the support rollers (see Fig. 6).

In the modification of Figs. 8 and 9, instead of the two lateral ribbed driving belts 5, there is used a central endless driving web 35 looped about two end driving drums 25. Driving web 35 is preferably made of rubber. This driving web 35 is comparatively wide and has angle elements 23 secured thereto, for example by riveting, screw connection, or the like. The angle elements 23 are secured to the centre webs 8 of the step slats 4. The connection points of the step slats 4 on driving web 35 should be as far apart as possible so that the slats 4 are guided truly perpendicularly to their running direction, without skew. The centre web 8 of the step slats 4 stops short of each end of the slats in order to provide room for the support rollers 12 and for the support belt 13. The undersides 14 of the step slats 4 are secured to the support belts 13. The driving drums 25 have radially projecting rims 30 in order to guide the driving web 35 and prevent any lateral excursion thereof. The driving drums are journalled by ball bearing 27 on a central shaft 26, secured to the frame structure or, in the embodiment shown, to the side wall of the housing 2. The step slats 4 are slightly shorter than the distance between the side walls of the housing 2, to provide for slight lateral clearance. The width of the driving web 35, however, is substantially less than the length of the slats 4, and preferably its width is about one-third of the length of the slats.

The arrangement of the moving surface can be horizontal or slightly inclined. Use of rubbery or other similar elastic material provides for low-noise operation. A typical overall length for the apparatus is about 2 metres, with a width of about $\frac{1}{2}$ metre, and a height above ground level of the upper run of the moving surface of about $\frac{1}{4}$ metre. A distance counter can be included in the box for the control element *C* to indicate, for example, the distance a user has run or walked while exercising on the device.

The support belt may be a flat belt 13 (Figs. 2, 4, 5) or a V-belt 13" (Fig. 7). If a V-belt is used, the support rollers are grooved or shaped to match, as seen at 12", to accept and centrally guide the V-belt 13".

Fig. 10 illustrates another embodiment in which the resilient support belt also acts as a driving belt and a section with teeth 7 and a smooth portion 36' to abut on support rollers 12.

Rollers 12 are carried on shafts 21 secured to bracket 19 which is attached to the side wall 2 of the apparatus. The connections of the bracket to the side wall, or to the frame of the apparatus may be by welding, for example.

The driving belt 5 may be wedge-shaped in the region 36', similarly to V-belt 13" (Fig. 7), with suitably modified rollers 12". Alternatively, an additional support belt, similar to belt 13, or 13", may be placed beneath belt 5 to provide for double cushioning. Fig. 10 illstrates the belt 5 in engagement with roller 12, i.e. the condition when the slat 4 is loaded, for example by the weight of the user.

WHAT I CLAIM IS:—

1. A movable surface apparatus, for physical exercise and training, comprising:

(i) a support frame
(ii) at least one pair of rotatable elements carried by the frame and having their axes substantially horizontal
(iii) belt means looped about said rotatable elements so as to include an upper run and a lower run
(iv) a plurality of transverse slat means secured externally on the belt means
(v) a plurality of support rollers disposed in a row beneath the upper run of the belt means with their axes of rotation parallel to each other and to the axis of rotation of the rotatable element
(vi) resiliently deformable cushioning means disposed between the support rollers and the underside of the slats for supporting the slats in cushioned manner.

2. A movable surface apparatus, as claimed in Claim 1, wherein the resiliently deformable cushioning means is in the form of support belt means looped about the plurality of support rollers.

3. A movable support surface apparatus, as claimed in Claim 2, wherein at least some of the support rollers have radial flanges between which at least a portion of the

support belt means is received so as to prevent shifting of the support belt means axially of the support rollers.

4. A movable support surface apparatus, as claimed in either of Claims 2 and 3, wherein an upper surface of an upper run of the support belt means is spaced by about ¼ cm. from the underside of the slats when the slats are not loaded.

5. A movable support surface apparatus, as claimed in any one of the preceding claims, wherein the step slats have an approximately T-shaped cross-section including a centre web which terminates short of each end of the slat.

6. A movable support surface apparatus, as claimed in Claim 1, wherein the cushioning means is in the form of a layer of resiliently deformable material secured on the underside of each slat, and wherein the support rollers have a diameter and a radial spacing with respect to the width of the step slats such as to provide support of the step slat by at least two support rollers at any time during movement of the slat.

7. A movable support surface apparatus, as claimed in any one of the preceding claims, further comprising a resiliently yieldable surface layer secured on the upper face of the slats.

8. A movable support surface apparatus, as claimed in Claim 7, wherein the resiliently yieldable surface layer comprises cork, dense foam rubber, sponge rubber, artificial lawn surfacing, indoor or outdoor carpeting having sponge or foam material backing, or plastics foam material.

9. A movable support surface apparatus, as claimed in Claim 1, wherein the belt means comprises a pair of axially spaced flexible belts located at the respective sides of the apparatus and adjacent the end portions of the slats, and wherein the slats are formed with projecting tongues secured to the endless belts, the width of the tongues being less than the width of the slats, and wherein the slats have a generally T-shaped cross section formed with a centre web, said centre web terminating short of each end of the slat by a distance which is greater than the length of the tongues.

10. A movable support surface apparatus, as claimed in Claim 1, wherein the belt means comprises a single endless belt located axially centrally of the apparatus.

11. A movable support surface apparatus, as claimed in Claim 10, wherein said single centrally located belt has a width of about one-third the length of the slats.

12. A movable support surface apparatus, as claimed in any one of Claims 1 to 11, wherein the support rollers are located adjacent the end portions of the slats to support the slats in a generally horizontal direction, the slats being formed to have sufficient stiffness along their length to prevent their bowing when supported by said rollers adjacent their ends and when loaded centrally by the weight of the user of the apparatus.

13. A movable support surface apparatus, as claimed in either of Claims 1 and 2, wherein the belt means and the resiliently deformable cushioning means comprise a single belt.

14. A movable support surface apparatus, as claimed in Claim 13, wherein the single belt has a ribbed section, in engagement with the rotatable elements, and a smooth section located above said support rollers for engagement with said support rollers when the slats are loaded by the weight of the user.

15. A movable surface apparatus, for physical exercise and training, substantially as described herein with reference to Figs. 1 to 4 or Fig. 5, or Fig. 6 or Fig. 7 or Figs. 8 and 9 of the accompanying drawings.

For the Applicants:
CHATWIN & COMPANY,
Chartered Patent Agents,
253 Gray's Inn Road,
London, WC1X 8QX.

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Sheet 1

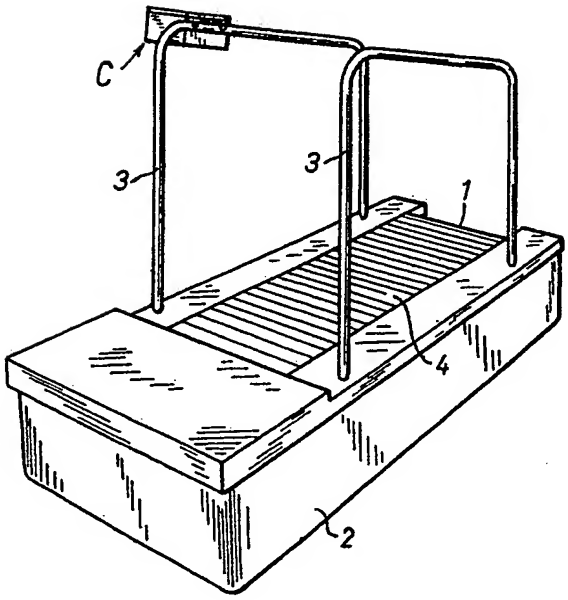


Fig. 1

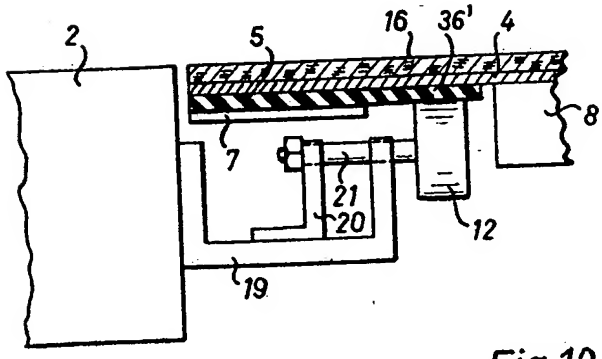
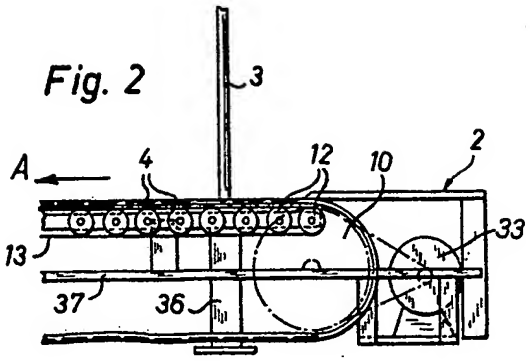


Fig.10

Fig. 2



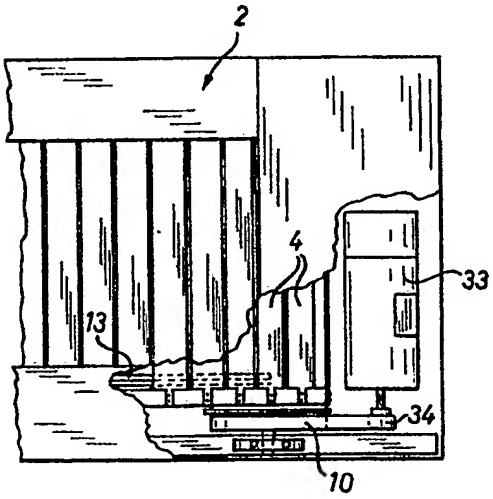


Fig. 3

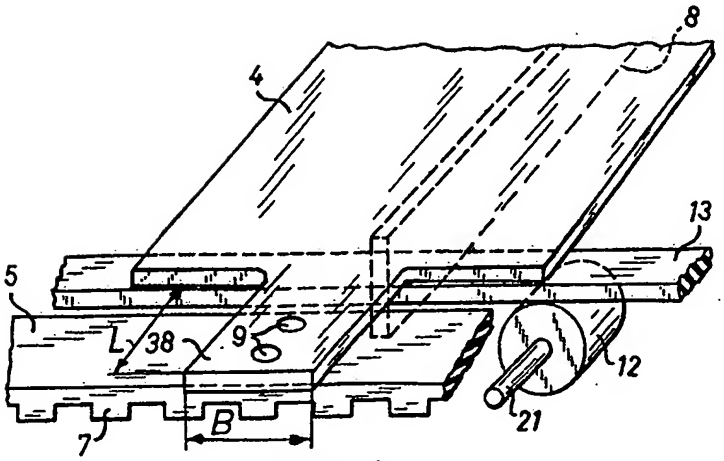


Fig. 4

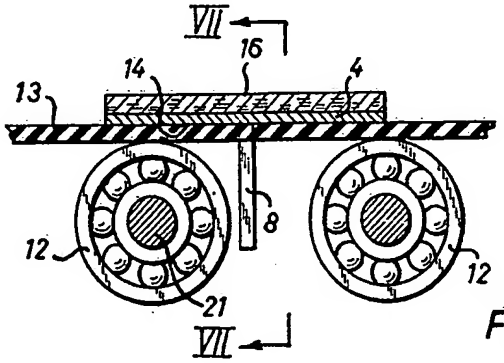


Fig. 5

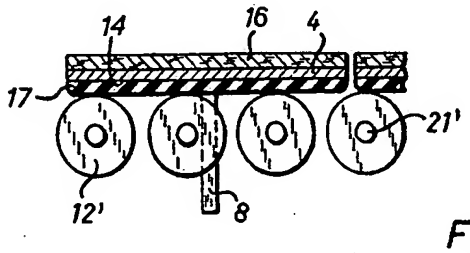


Fig. 6

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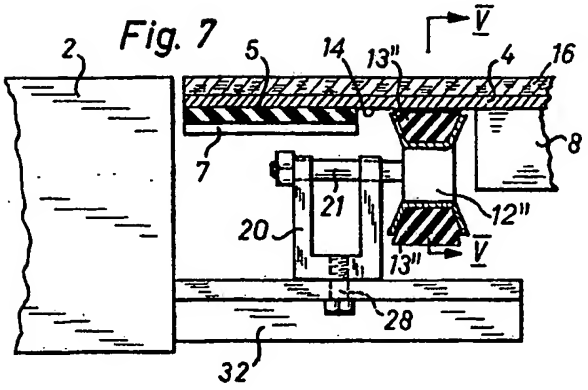
Sheet 4

Fig. 7



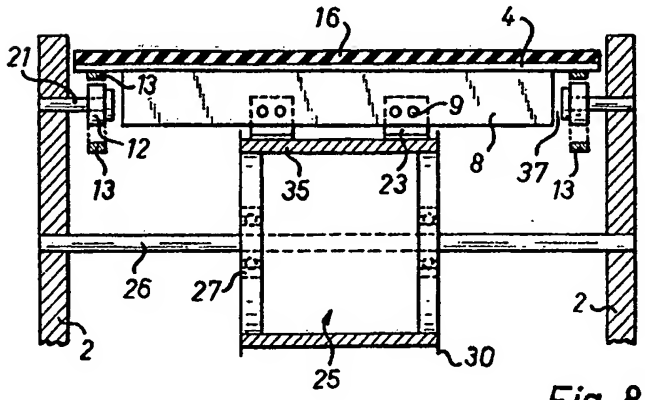


Fig. 8

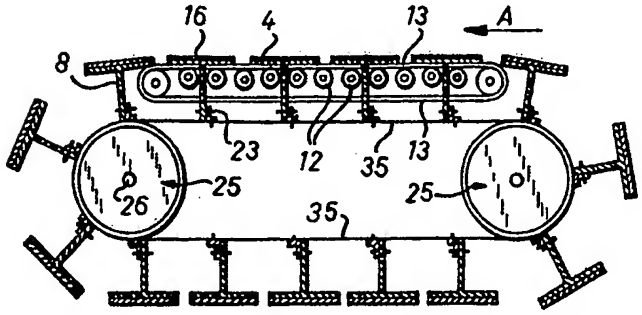


Fig. 9